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RECONNAISSANCE GEOCHEMICAL STREAM SEDIMENT SURVEY OF THE HAWKS MOUNTAIN AND THE LONE MOUNTAIN AREAS HARNEY COUNTY, OREGON

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RECONNAISSANCE GEOCHEMICAL STREAM SEDIMENT SURVEY OF THE HAWKS MOUNTAIN AND THE LONE MOUNTAIN AREAS HARNEY COUNTY, OREGON

by

Durga Rimal, Oregon State Office

Dennis Simontacchi, Lakeview District Office

George Brown, Burns District Office

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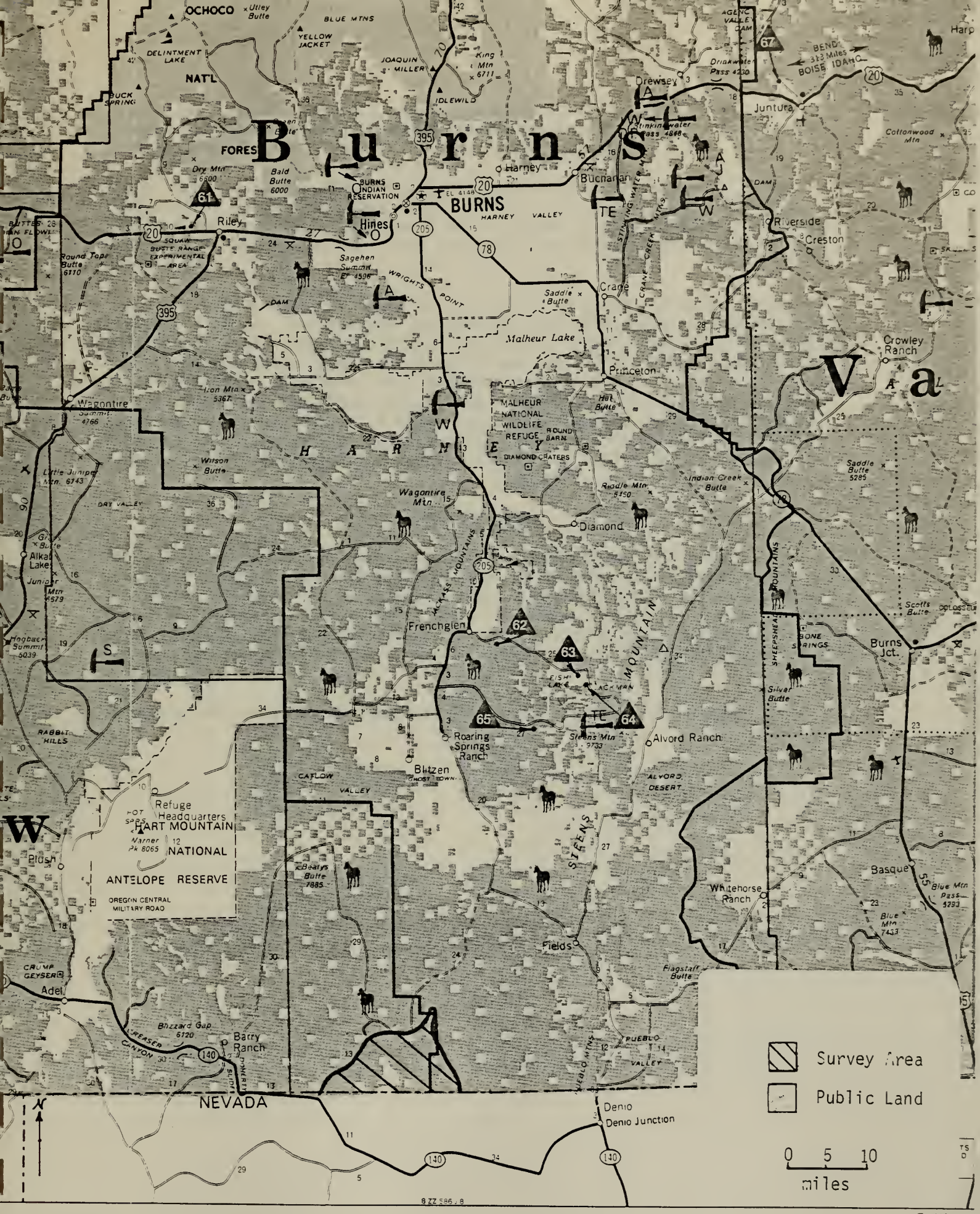


Figure No.1 - Location and access map of the survey area

Vegetation consists of big sagebrush community with sparsely scattered junipers and occasional patches of mountain mahogany on higher elevations. Much of Hawks Valley is seeded in crested wheatgrass.

The climate is semiarid with a large fluctuation in temperature. Annual temperatures range from about -30°F in winter to over 105°F in summer. Precipitation typically averages 8 to 14 inches, with the higher elevation getting most precipitation. Most precipitation falls as winter rains and snows.

The study area belongs to Great Basin section of Basin and Range province (Fenneman, 1931). The drainage is internal with ephemeral streams draining into playas or disappearing in alluvial fans or volcanic flows. The typical surface expression of Basin and Range province is fault block mountains and graben valleys. In Oregon such parallel valleys and ranges have a northerly grain. This regional grain is modified and obscured in this area by later faulting and/or volcanism. A major northwest trending fault zone, termed Eugene-Denio Lineament by Lawrence (1976), passes through the Hawks Valley depression. It separates the Hawks Mountain and Lone Mountain Ranges.

PREVIOUS WORK

There is very little geologic information available for the area. A reconnaissance geologic map was published by Walker and Repenning (1965) on a scale of 1:250,000. An aeromagnetic map of the same scale was prepared by the U. S. Geological Survey as an open file report in 1972. The adjoining area in Nevada, the Charles Sheldon Wilderness Study Area, was examined for its mineral potential by the U. S. Geological Survey and the Bureau of Mines (Cathrall and others, 1978).

There are no known mineral deposits or mining claims in the subject area.

PRESENT WORK

During June 6-9, 1980 Durga Rimal of Oregon State Office, Dennis Simontacchi of the Lakeview District Office and George Brown of Burns District Office conducted the field work. A total of 51 stream sediment samples were collected in paper envelopes with plastic spoons. All but one of these samples were from dry streams, and consisted of fine sediments from the main stream channels. The samples were seived and the -80 mesh fractions were analyzed by Scienterra Inc. of Spokane, Washington.

Methods of analysis: Uranium digested in concentrated nitric acid analyzed by laser-induced fluorescence; other analyses by atomic absorption; Mercury utilizing hydride-generation method; Gold extraction with aqua regia, subsequent separation in organic phase.

Statistical analysis of the data using cumulative frequency plots were done by Durga Rimal. Linear regression analyses was done by George Hartman of the Oregon State Office.

ACKNOWLEDGMENTS

Pete Talbot, foreman of the MC Ranch, graciously allowed the field party to stay at the Acty Cow Camp effecting a considerable saving on the field work time. Special thanks are due to George T. Hartman for the regression analysis of the sample data.

GEOLOGY

According to Walker and Repenning's reconnaissance mapping (1965), the dominant rock units in the study area are Tertiary continental volcanic rocks. No rocks older than Miocene (12 million years) are represented.

Map No. 1 shows the surface distribution of various rock units which are described in the following table:

Qp	Playa deposits, clay, silt, sands, some evaporite	Recent
Qal	Unconsolidated fluvatile gravel, sand and silt	Pliestocene
Qtba	Flows of basalt with minor basaltic andesite, commonly vesicular	Pliestocene and late Pliocene
Tst	Semiconsolidated tuffaceous lake sediments includes ashy diatomite	Pliocene
Tob	Mostly thin, black, vesicular basalt flows	Pliocene
Ttr	Partly to densely welded tuffs of rhyolitic to dacitic composition. Some rhyolitic and dacitic flows. Grades laterally to exogenous domes QTvf. Ttr is part of a larger unit Ttf which includes fine-grained tuffaceous units.	Pliocene Miocene
QTvf	Mostly large, complex, exogenous domes and related flows and flow breccias of rhyodacitic composition. Includes small vent areas composed largely of breccias and, coarse highly altered welded tuff.	Miocene
Tbf	Massive basalt flows and minor interbeds of tuffs and scoria	Miocene (Middle ? and late)
Taf	Mostly andesitic flows, contains some basalts and tuffaceous sediments	Miocene (Middle ? and late)

About 85% of the surface of the study area is covered by 3 rock formation units QTvf, Ttr, and Tst which are evenly represented. All are rhyolitic and dacitic in composition and represent various phases of volcanic lithology e.g., exogenous dome, flows, tuffs, and tuffaceous sediments.

The remaining portion of the surface is covered equally by the basaltic units (QTba, Tob, and Tbf) and Quaternary unconsolidated alluvium and playa beds (Qal and Qp).

MAP NO. 1 -- GEOLOGIC AND AEROMAGNETIC MAP

Geology from Walker and Repenning (1965)
Magnetic contours from USGS Open File Map, 1972

QTvf, Tst, Tob, Ttr etc - Geologic symbols,
Refer to the text for explanation.

3000 — Magnetic contours, showing the total-intensity magnetic field of the earth relative to an arbitrary datum. Regional gradient of about 5 gammas per Km has been removed. Hachures enclose magnetic minima. Contour interval is 100 gammas.

Magnetic data were obtained along east-west lines flown at a spacing of about 3.2 Km and at a nearly constant barometric elevation of 2743 m above sea level.

Normal fault

Contact

SCALE

KILOMETRES 0 1 2 3 4 5 6 7 8 9 10

MILES 0 1 2 3 4 5

FEET 5000 0 5000 10000 15000 20000 25000

NATIONAL GEODETIC VERTICAL DATUM OF 1929

ELEVATIONS SHOWN IN METRES
TRIANGULATION STATION ELEVATIONS SHOWN IN FEET

GEOCHEMICAL STREAM SEDIMENT SURVEY OF HAWKS MOUNTAIN AND LONE MOUNTAIN AREAS HARNEY GOUNTY, OREGON

Durga Rimal
Dennis Simontacchi
George Brown

Bureau of Land Management, Oregon
October, 1980

Location

Numerous prominent normal faults occur in the study area. They are observed to align into 3 sets with general directions of N40E, N to N10E, and N50W. The N50W set is responsible for a sharp depression that separates the Hawks Mountain from the Lone Mountain ranges. This feature makes the southern part of the Lawrence's (1976) Eugene - Denio Lineament, a right - lateral slip fault system, similar to Brothers Fault, Mount McLoughlin Zone and Vale Zone. These series of strike - slip fault systems have supposedly terminated the Basin and Range fault systems and constitute the northern boundary of the Basin and Range Province. As such these lineaments may represent the surface manifestations of major breaks in the earth's basement. From the economic minerals point of view it should be noted that the Eugene - Denio lineament aligns well with the highly mineralized Battle Mountain - Eureka lineament in Nevada.

AEROMAGNETIC DATA

The magnetic contours shown on Map No. 1 is derived from a U. S. Geological Survey Open-File Report, 1972. Total intensity magnetic data were obtained along east-west lines flown at a spacing of about 3.2 Km and at a nearly constant barometric elevation of 2743 m above sea level. The approximate effect of earth's normal magnetic field has been removed from the observed total intensity data by subtracting a regional gradient of about 5 gammas per kilometer in the direction of magnetic north.

A conspicuous magnetic high is observed near the center of the study area, at the Hawks Mountain. This magnetic maxima of 800 gammas at first appears to be caused mainly by the topographic effects of the domal masses and flows of rhyodacite-dacite (QTvf) formations. However, Plouff (in Cathrall and others, 1978) has noted that the area of high magnetization is much more extensive when one takes into account the outermost closed contour of 2600 gammas. Based on the correlation of mineral deposits and volcanic centers in several areas in Nevada (Albers and Kleinhampl, 1970), Plouff considers this volcanic center also to be a favorable location for mineral occurrences.

GEOCHEMICAL SAMPLE EVALUATION

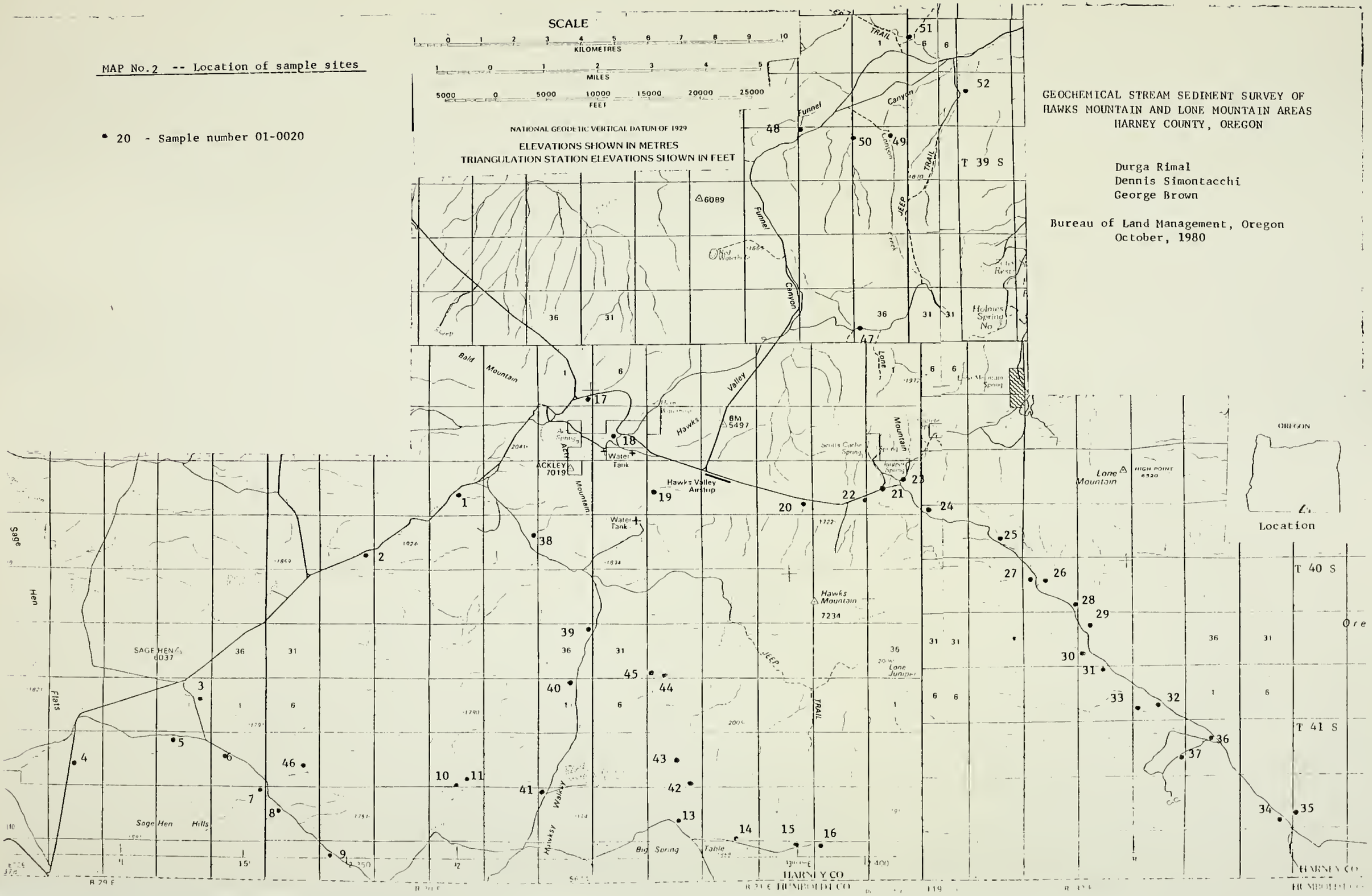
Map No. 2 shows the location of the sample sites. Table No. 1 gives the result of the analyses of the samples. Statistical summary of the analyses of the samples are shown in Table No. 2

Out of the 15 metals analysed for in the 51 samples as shown in Table No. 2, four namely antimony, cadmium, molybdenum and silver were found in detectable quantities in less than 30 samples. Due to insufficient data they have not been considered in estimating threshold values.

Threshold values are defined as the upper limit of a normal background value, or a lower limit of concentration of an element to be considered anomalous. Anomalous values may be related to mineral deposits and are worthy of careful scrutiny.

MAP No.2 -- Location of sample sites

• 20 - Sample number 01-0020



GEOCHEMICAL STREAM SEDIMENT SURVEY OF
HAWKS MOUNTAIN AND LONE MOUNTAIN AREAS
HARNEY COUNTY, OREGON

Durga Rimal
Dennis Simontacchi
George Brown

Bureau of Land Management, Oregon
October, 1980

Threshold values may be estimated statistically or may be recognized by plotting cumulative frequencies on logarthmic probability paper. Figure No. 3 shows such a plot for gold in stream sediments of the study area. The plot defines two straight lines representing two sets of populations. The intersection of these lines defines the threshold value. Such a clean demarcation of threshold values were not apparent from cumulative frequency plots for the remaining 10 metals. Threshold values for these elements were estimated based on statistics. Generally the mean value plus two standard deviations of the values were taken as a threshold value. Estimated threshold values are shown in Table No. 3.

Map No. 3 shows the location of the samples for each metal that exceed these threshold values.

Table No. 1 ANALYTICAL DATA REPORT

ppm - parts per million;
ppb - parts per billion;

Sample No.	U (ppm)	Co (ppm)	Ni (ppm)	Cd (ppm)	Pb (ppm)	Cu (ppm)	Mn (ppm)	Mo (ppm)	Ag (ppm)	Ba (ppm)	Zn (ppm)	Sb (ppm)	As (ppm)	Au (ppb)	Hg (ppb)
01-0001	2.8	11	6	<.2	10	16	1195	1	<.2	650	563	<.5	6	20	35
01-0002	2.2	10	9	.3	11	20	1010	1	<.2	649	656	<.5	7	170	25
01-0003	1.4	16	9	.2	9	17	1180	<1	<.2	675	344	<.5	8	12	35
01-0004	2.1	10	6	.4	10	17	1480	<1	<.2	750	642	<.5	8	11	20
01-0005	.6	11	6	<.2	8	14	738	<1	<.2	625	344	<.5	7	20	10
01-0006	2.6	14	9	<.2	8	16	1120	1	<.2	600	406	<.5	7	12	25
01-0007	2.0	6	4	.2	7	14	763	<1	.2	500	430	<.5	6	14	20
01-0008	1.2	5	4	<.2	8	12	660	1	<.2	400	352	<.5	5	16	10
01-0009	1.3	5	4	<.2	7	9	545	<1	<.2	425	281	<.5	6	11	5
01-0010	1.4	13	7	<.2	8	12	955	<1	<.2	423	313	<.5	6	16	10
01-0011	1.8	9	3	<.2	12	9	860	<1	<.2	475	340	<.5	8	8	15
01-0013	2.2	8	4	<.2	11	9	705	1	<.2	775	336	<.5	9	10	5
01-0014	1.2	8	4	<.2	9	12	880	1	<.2	650	391	<.5	8	18	10
01-0015	1.4	10	5	.3	11	11	1110	<1	<.2	725	422	<.5	6	18	15
01-0016	.9	8	5	.2	11	11	895	1	<.2	625	305	<.5	7	12	15
01-0017	1.3	9	5	<.2	13	10	845	1	<.2	675	250	<.5	6	15	10
01-0018	1.8	3	3	<.2	9	8	598	1	<.2	500	508	<.5	5	20	5
01-0019	1.9	4	3	<.2	12	9	680	<1	<.2	550	344	<.5	5	17	10
01-0020	1.5	8	4	.3	10	14	965	1	<.2	650	367	<.5	7	40	15
01-0021	1.5	5	3	<.2	6	10	623	<1	<.2	950	383	<.5	6	13	< 5
01-0022	1.7	6	3	<.2	6	8	668	1	<.2	825	313	<.5	5	10	5
01-0023	2.8	3	2	<.2	8	4	405	2	<.2	750	281	<.5	6	15	10
01-0024	1.4	7	4	<.2	8	10	925	2	<.2	1000	508	<.5	5	13	< 5
01-0025	2.3	2	1	<.2	15	4	333	1	.2	450	1109	<.5	4	10	5
01-0026	1.3	4	2	<.2	8	7	745	1	.2	500	453	<.5	12	11	10
01-0027	1.1	3	1	<.2	5	5	513	<1	<.2	375	266	<.5	5	12	5
01-0028	.8	4	3	<.2	6	6	388	2	<.2	425	445	<.5	15	13	10
01-0029	.8	5	3	<.2	7	7	543	1	<.2	800	281	<.5	7	15	5
01-0030	1.2	5	2	<.2	9	9	558	2	<.2	700	219	<.5	6	12	20
01-0031	.8	4	2	<.2	7	8	340	<1	<.2	800	266	<.5	5	11	5

Sample No.	U (ppm)	Co (ppm)	Ni (ppm)	Cd (ppm)	Pb (ppm)	Cu (ppm)	Mn (ppm)	Mo (ppm)	Ag (ppm)	Ba (ppm)	Zn (ppm)	Sb (ppm)	As (ppm)	Au (ppb)	Hg (ppb)
01-0032	1.3	4	3	<.2	4	10	368	<1	<.2	700	305	<.5	5	9	5
01-0033	1.0	4	2	<.2	9	8	475	1	<.2	675	297	<.5	6	10	10
01-0034	.3	8	19	<.2	5	10	428	<1	<.2	500	242	<.5	8	20	5
01-0035	1.1	7	5	.2	8	14	718	2	<.2	475	414	<.5	7	10	20
01-0036	1.1	4	2	<.2	6	4	450	1	<.2	600	203	1.4	5	8	5
01-0037	.8	5	7	<.2	5	9	445	<1	<.2	625	211	<.5	5	9	10
01-0038	1.6	7	3	<.2	10	12	975	3	<.2	500	516	<.5	6	10	15
01-0039	1.6	8	5	<.2	12	11	1055	<1	<.2	400	523	<.5	6	11	15
01-0040	1.1	10	6	<.2	10	11	1040	<1	<.2	475	375	<.5	6	15	10
01-0041	1.0	8	4	<.2	9	8	935	2	<.2	375	242	<.5	5	15	10
01-0042	1.3	6	2	<.2	7	8	620	<1	<.2	700	508	<.5	8	17	10
01-0043	1.0	6	3	<.2	7	11	738	1	<.2	500	492	<.5	7	20	10
01-0044	1.3	7	4	.2	12	13	1040	1	<.2	625	531	<.5	6	20	20
01-0045	1.2	6	3	<.2	9	10	980	<1	<.2	525	414	<.5	8	30	5
01-0046	.8	5	3	<.2	8	7	625	<1	<.2	450	273	<.5	6	12	5
01-0047	.8	6	3	<.2	4	8	683	<1	<.2	1400	383	<.5	7	12	10
01-0048	.5	6	3	<.2	5	6	240	<1	<.2	750	188	<.5	6	8	< 5
01-0049	.8	8	5	.2	12	11	865	2	<.2	425	367	<.5	7	10	15
01-0050	1.0	11	5	.2	11	14	1060	1	<.2	625	438	<.5	7	9	30
01-0051	.5	5	4	<.2	4	7	523	1	<.2	620	375	<.5	8	8	5
01-0052	.8	9	4	<.2	7	9	815	1	<.2	650	352	<.5	8	9	15

Analyses by Scienterra, Inc., N. 6027 Division Street, Spokane, WA 99207.

Uranium digested in concentrated nitric acid analyzed by laser-induced fluorescence; other analyses by atomic absorption; Mercury utilizing hydride-generation method; gold extraction with aqua regia, subsequent separation in organic phase.

TABLE NO. 2

Statistical Summary of Analytical Results for Stream Sediments
(Values for Au and Hg are in ppb (parts per billion*); All other values are reported in ppm (parts per million); Leaders (--), insufficient data.)

Metal	Detectable Values		Lower Limit of Detection	Percentile Distribution				Mean	Standard Deviation
	Range	No. of		25th	50th	75th	90th		
Sb	1.4	1	.5	--	--	--	--	--	-
As	4-15	51	1	6	6	7	8	6.7	1.8
Ba	375-1400	51	5	475	625	700	800	617	183
Cd	.2-.4	11	.2	--	--	.2	.3	--	-
Co	2-16	51	1	5	6	9	11	7	3.0
Cu	4-20	51	1	8	10	12	14	10.2	3.5
Au*	8-170	51	1	10	12	17	20	17	22.6
Pb	4-15	51	1	7	8	10	12	8.5	2.5
Mn	240-1480	51	1	543	738	965	1060	751	269
Hg*	5-35	48	5	5	10	15	20	11.8	8.1
Mo	1-3	29	1	--	1	1	2	--	-
Ni	1-19	51	1	3	4	5	7	4.3	2.8
Ag	.2	3	.2	--	--	--	--	--	-
U	.3-2.8	51	.2	.9	1.3	1.6	2.2	1.3	.6
Zn	188-1109	51	.5	281	367	445	523	388	150

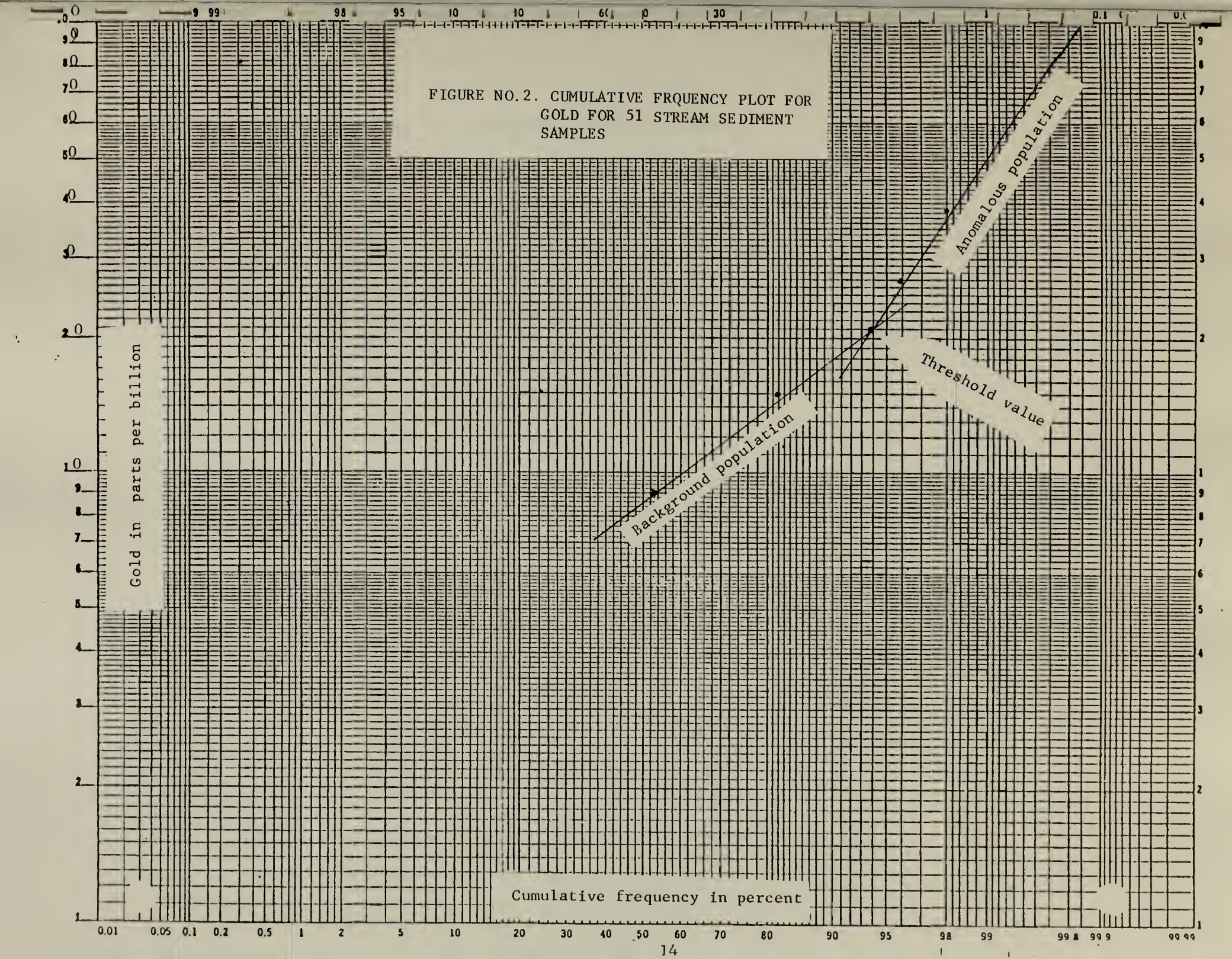


FIGURE NO. 2. CUMULATIVE FRQUENCY PLOT FOR GOLD FOR 51 STREAM SEDIMENT SAMPLES

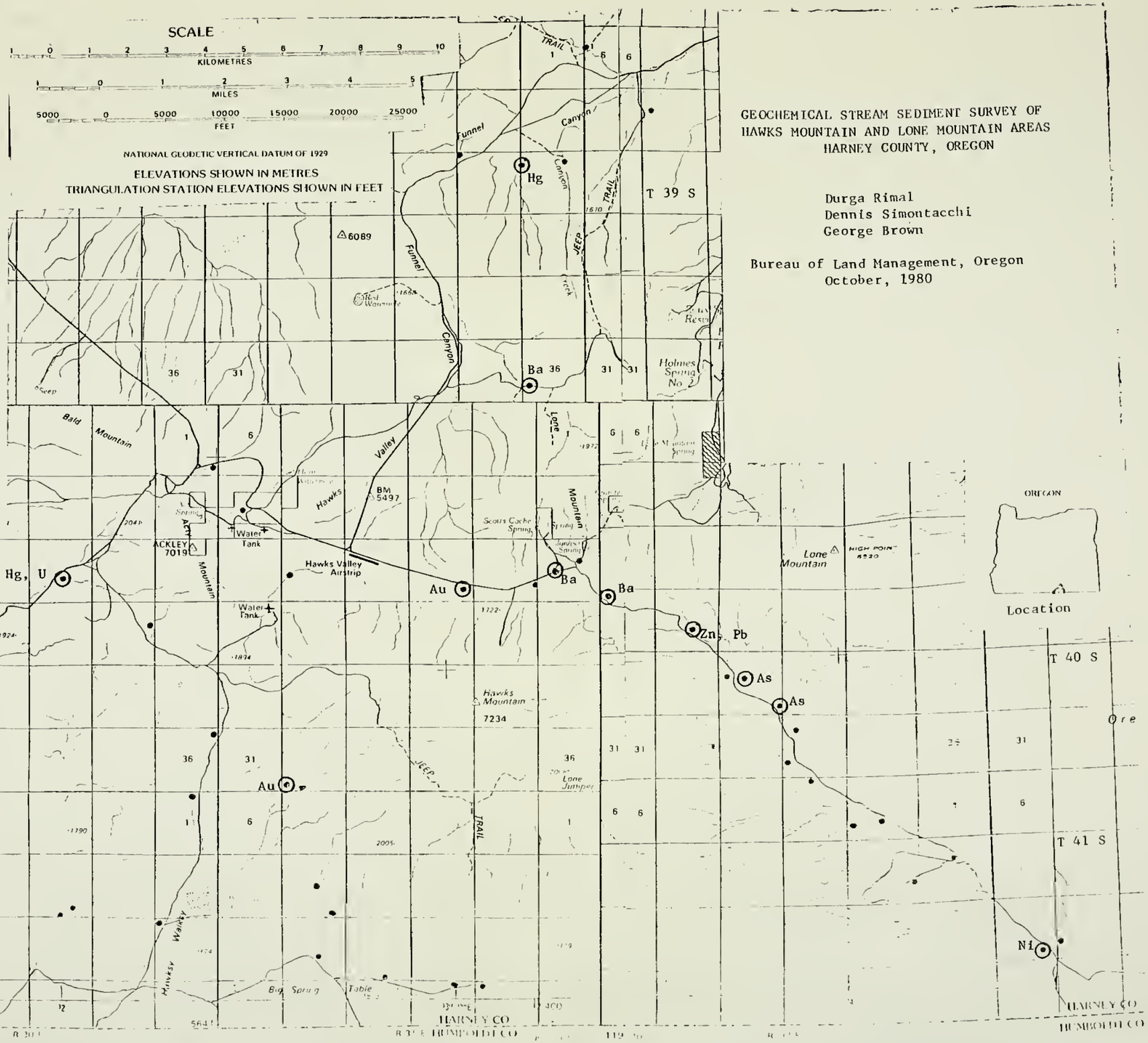
Table No. 3 GEOCHEMICAL THRESHOLD VALUES

Metal	Threshold Values
Arsenic	11 ppm (parts per million)
Barium	940 ppm (parts per million)
Cobalt	13 ppm (parts per million)
Copper	18 ppm (parts per million)
Gold	21 ppb (parts per billion)
Lead	14 ppm (parts per million)
Manganese	1290 ppm (parts per million)
Mercury	28 ppb (parts per billion)
Nickel	10 ppm (parts per million)
Uranium	2.5 ppm (parts per million)
Zinc	690 ppm (parts per million)

Map No.3 -- Location of sample sites with anomalous values of one or more metals.

- • Sample sites
- ⊙ Sample sites with anomalous values

As - Arsenic Ba - Barium
Co - Cobalt Cu - Copper
Au - Gold Pb - Lead
Mn - Manganese Hg - Mercury
Ni - Nickel U - Uranium
Zn - Zinc



GEOCHEMICAL STREAM SEDIMENT SURVEY OF
HAWKS MOUNTAIN AND LONE MOUNTAIN AREAS
HARNEY COUNTY, OREGON

Durga Rimal
Dennis Simontacchi
George Brown

Bureau of Land Management, Oregon
October, 1980

Parameters that affect the metal content in sediment samples are many and often not routinely measurable. The influence of bedrock geology is however critical and will be discussed further.

The study area belongs to a continental volcanic terrane, predominantly rhyolitic to dacitic in composition. About 8% of the surface area has basaltic outcrops with another 7% covered by playas and alluvium. The playa and alluvium covered areas were excluded from the sampling grid.

Table No. 4 shows the abundance of selected metals in the continental crust. The magnitude of trace elements in the average bedrock of the area are probably of the same order. For comparison sake chemical analyses of the tephra of March 27, 1980 eruption of Mt. St. Helens is shown in Table 5, as reported by McLucas (1980) from the U. S. Geological Survey Open File Report 80-740 (Shulters and Clifton, 1980). The overall petrographic evaluation of Mount St. Helens tephra corresponds to a dacitic-andesitic magma.

The influence of bedrock geology of the watershed to the stream sediment composition of the study area is demonstrated by the cobalt/nickel ratios. In the present survey the rock outcrops are, as mentioned earlier, mostly of rhyolitic and dacitic composition. Cobalt enrichment in relation to nickel in silicic rock as compared to basic rocks is well documented (Rankama and Sahama, 1950). High cobalt to nickel ratios were observed in the stream sediments sampled in the present study. Only 4% of the stream sediments have cobalt to nickel ratio of less than 1. Statistics for cobalt to nickel ratios are: range .42 to 3; 25th percentile 1.5; 50th percentile 1.8; 75th percentile 2.0; 90th percentile 2.3; and standard deviation .5. The low ratio of .42 was observed in Sample No. 01-0034. It had a relatively high nickel content of 19 ppm. This sample was collected from a creek whose watershed appears to be a dominantly basaltic formation (QTba).

The mutual relationship of selected metals with each other and other trace elements were investigated through regression analysis. Regression coefficient (R) was computed using UCLA (1965) version stepwise regression adapted to Control Data Corporation 6400 Computer by University of Colorado and compiled by PNW, October, 1968. Regression equations yielded an F (variance ratio) statistic which was significant at the 95% level.

R and R^2 values between gold and zinc and other metals were calculated. They are shown in Table No. 6. R value in excess of .45, or R^2 (coefficient of determination) value in excess of 20% is taken as a good correlation. R^2 gives percentage of the variance in one metal associated with other metals. It is seen that gold has good positive correlation with copper whereas zinc has good positive correlation with lead, uranium and silver. Manganese has poor correlation with both gold and zinc.

Table 4. Abundance of selected metals in the continental crust in parts per million (ppm), according to Taylor (1964) and Mason (1958).

Metal	Taylor	Mason
Antimony	.2	.2
Arsenic	1.8	2
Barium	425	400
Cadmium	.2	.2
Cobalt	25	23
Copper	55	45
Gold	.004	.005
Lead	12.5	15
Manganese	950	1000
Mercury	.08	.5
Molybdenum	1.5	1
Nickel	75	80
Silver	.07	.1
Uranium	2.7	2
Zinc	70	65

Table 5 - Semiquantitative Analyses of Volcanic Ash for Selected Metals from Mount St. Helens, March 27 Eruption (Shulters and Clifton, 1980)

Metal	Parts per Million (ppm) By Weight
Antimony	Not Determined
Arsenic	2
Barium	300
Cadmium	.2
Cobalt	20
Copper	30
Gold	<.2
Lead	10
Manganese	700
Mercury	Not Determined
Molybdenum	Not Determined
Nickel	10
Silver	Not Determined
Uranium	Not Determined
Zinc	100

Table No. 6 Coefficient of Correlation and Coefficient of Determination Between Gold and Zinc and Other Variables.

Gold			Zinc		
Independent Variable	R	R^2	Independent Variable	R	R^2
Copper	.45	20%	Lead	.49	24%
Cadmium	.37	14%	Uranium	.48	23%
Zinc	.26	7%	Silver	.46	22%
Nickel	.26	7%	Manganese	.29	8%
Mercury	.24	6%	Gold	.26	7%
Uranium	.23	5%	Cadmium	.26	7%
Manganese	.20	4%	Copper	.24	6%
CO/Ni ratio	.20	4%	Mercury	.23	5%
All other Metals	<.20	< 4%	All other Metals	<.20	< 4%

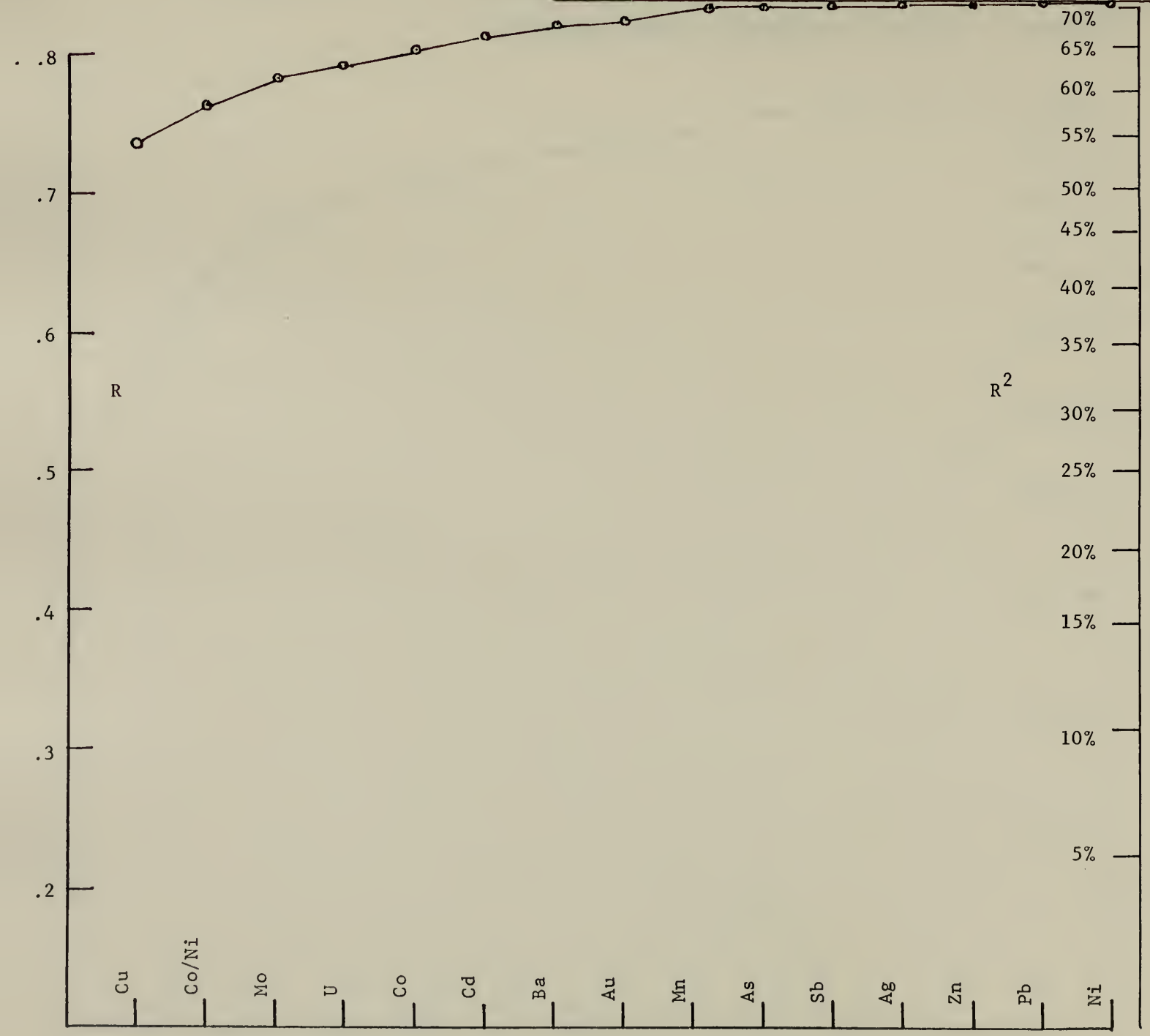
A cumulative relationship of various independent variables to the desired metal (dependent variable) may be used to understand the distribution of the desired metal. The aim being to be able to separate an anomalous value of the desired metal from a predictable value based on independent variables. Gold, mercury, uranium and zinc were selected as dependent variables, and for each of these a cumulative correlation coefficient (R) and coefficient of determination (R2) were calculated using stepwise regression method. The results are graphically depicted in figures 4 through 7. Summary tables are also provided.

It can be seen that mercury has extremely good correlation with copper (54%); zinc has good correlation with lead plus silver plus gold (44%); uranium with zinc plus mercury (30%); and gold with copper plus cobalt (27%). Interpretation of mercury values in further refining anomalous areas seems to have the highest potential through this approach.

The very good correlation between copper and mercury as well as between gold and copper are very interesting in terms of possible mineralization in the area as these could reflect their common hydrothermal ancestry. The good correlation observed between zinc with lead and silver is consistent with such a hypothesis.

Another interesting feature is the clustering together of the anomalous barium values in the stream sediments on the west side of the Lone Mountain. Barium itself is not considered of economic significance in the present geologic environment. It may be used as an indicator element. Barium enrichment may represent hydrothermal leakage zones along fractures in the host rock associated with spatially related concealed precious and base metal mineralizations.

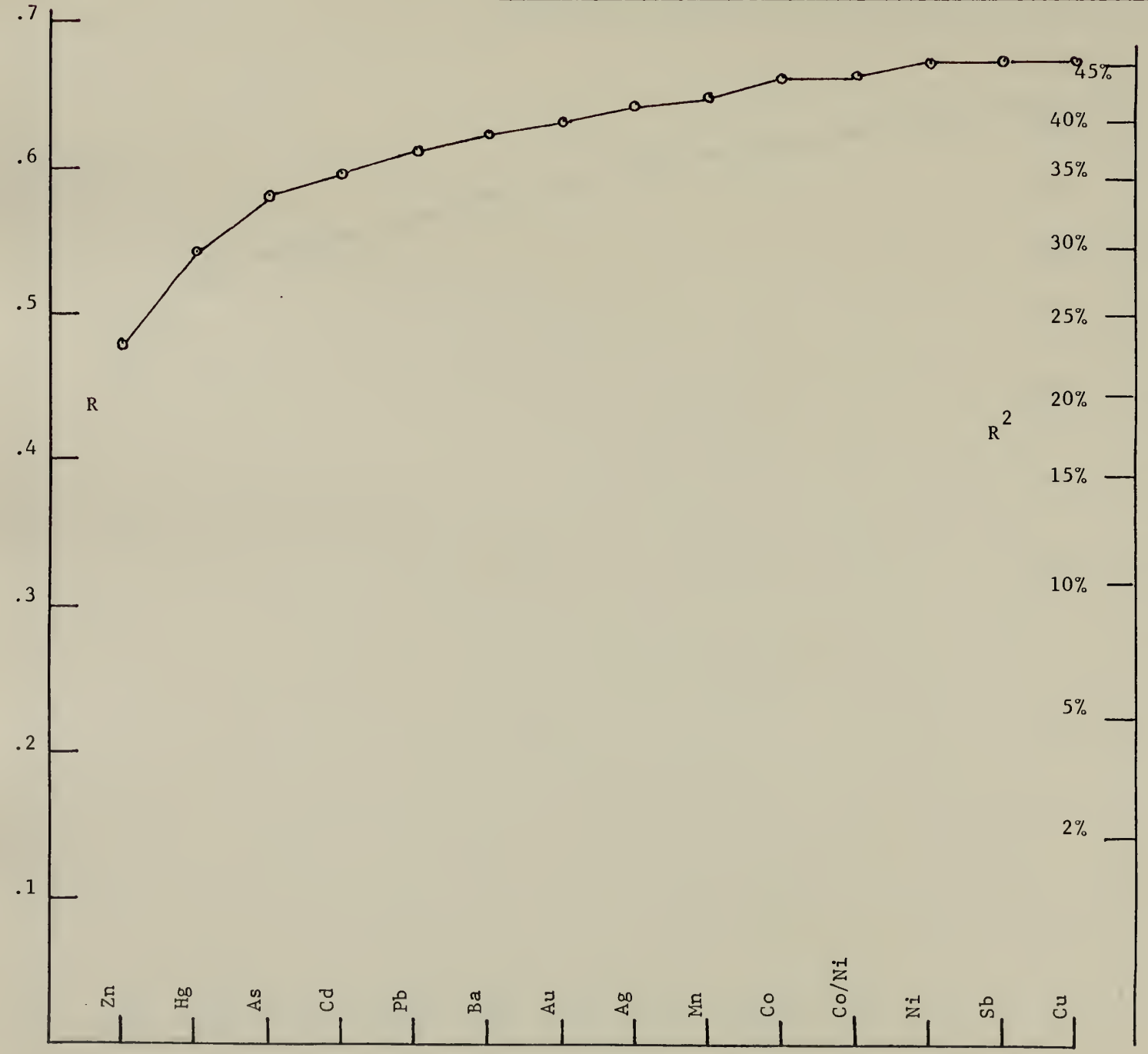
FIGURE NO.3 -- RELATIONSHIP OF COEFFICIENT OF CORRELATION (R) OF MERCURY (dependent variable) and coefficient of determination (R^2) WITH OTHER METALS (independent variables) -- cumulative



MERCURY
Summary Table of cumulative values

	R	R^2
Copper	.74	54%
Cobalt/ Nickel ratio	.76	58%
Molybdenum	.78	61%
Uranium	.79	63%
Cobalt	.80	65%
Cadmium	.82	66%
Barium	.82	67%
Gold	.83	68%
Manganese	.83	69%
Arsenic	.83	70%
Antimony	.84	70%
Silver	.84	70%
Zinc	.84	70%
Lead	.84	70%
Nickel	.84	70%

FIGURE NO.4 -- RELATIONSHIP OF COEFFICIENT OF CORRELATION (R) OF URANIUM (dependent variable) WITH OTHER METALS (independent variables) -- cumulative and coefficient of determination (R^2)

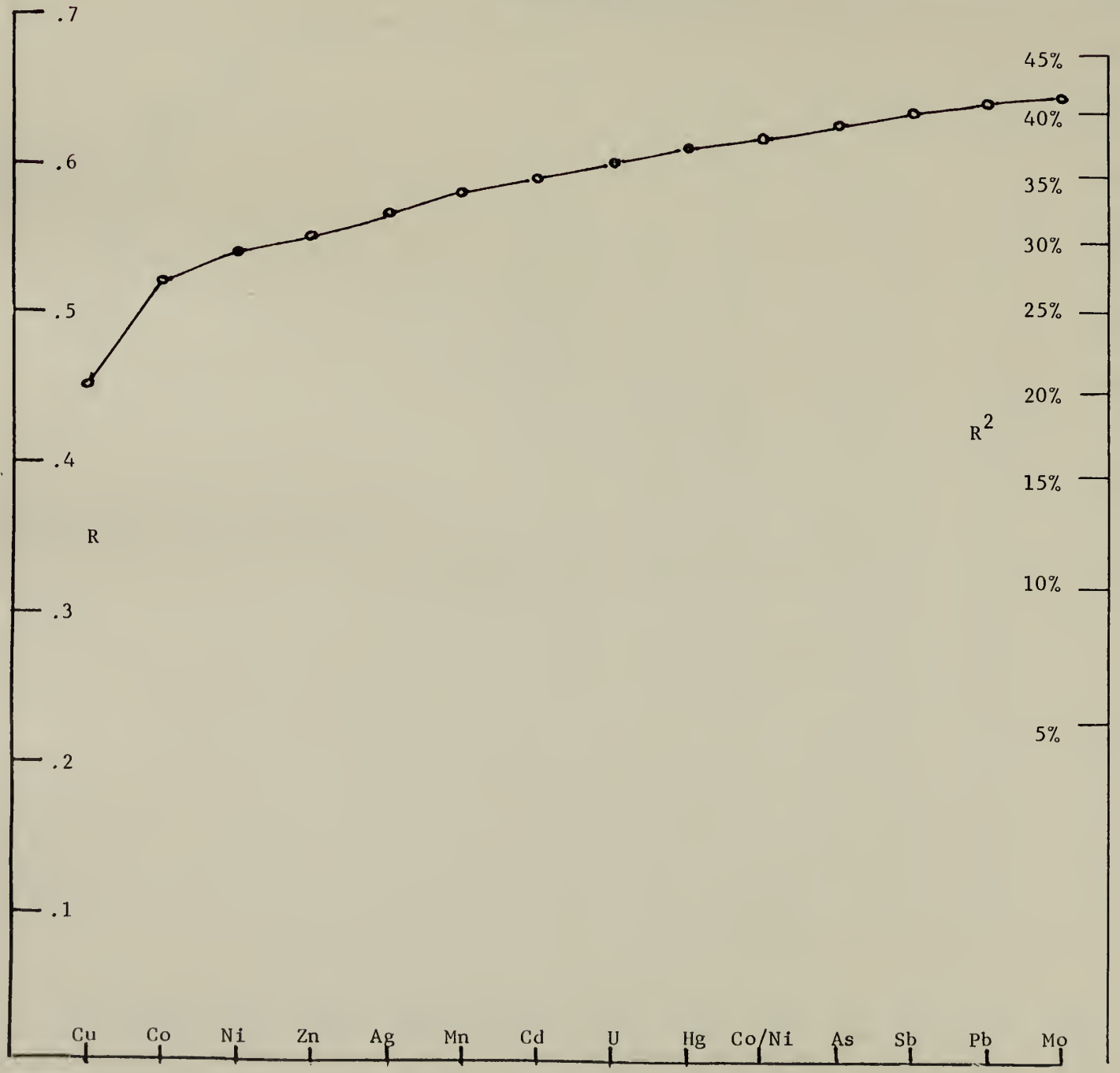


URANIUM
Summary Table of cumulative values

	R	R^2
Zinc	.48	23%
Mercury	.54	30%
Arsenic	.58	34%
Cadmium	.60	36%
Lead	.61	38%
Barium	.63	39%
Gold	.63	40%
Silver	.64	41%
Manganese	.65	42%
Cobalt	.66	44%
Cobalt/ Nickel ratio	.67	45%
Nickel	.67	45%
Antimony	.67	46%
Copper	.68	46%

and coefficient of determination (R^2)

FIGURE NO. 5 -- RELATIONSHIP OF COEFFICIENT OF CORRELATION (R) OF GOLD (DEPENDENT VARIABLE) WITH OTHER METALS (INDEPENDENT VARIABLES) -- cumulative

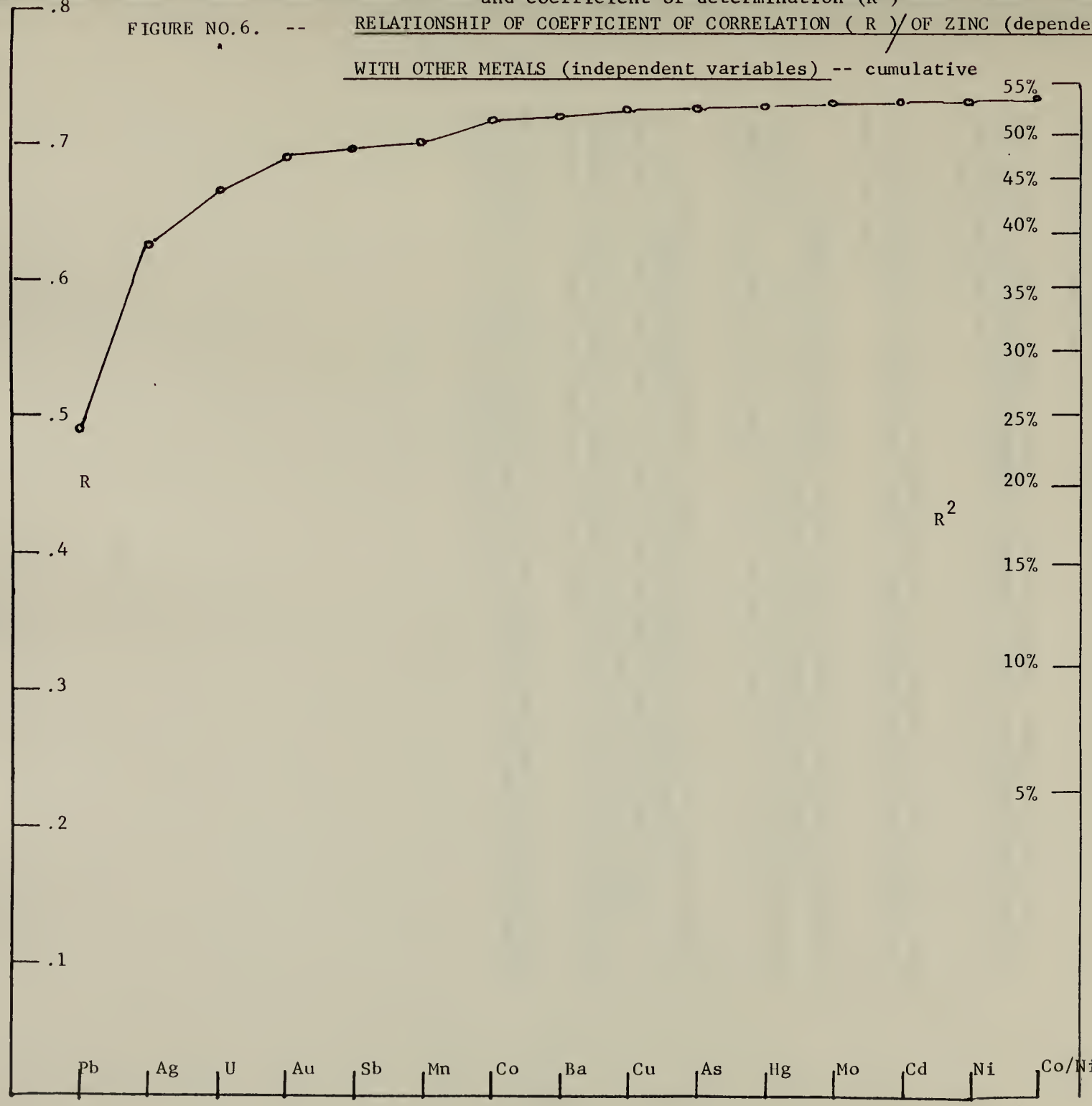


GOLD
Summary Table of cumulative values

	R	R^2
Copper	.45	20%
Cobalt	.52	27%
Nickel	.54	29%
Zinc	.55	30%
Silver	.57	32%
Manganese	.58	34%
Cadmium	.59	35%
Uranium	.60	36%
Mercury	.61	37%
Cobalt/ Nickel ratio	.62	38%
Arsenic	.63	39%
Antimony	.63	40%
Lead	.64	41%
Molybdenum	.64	41%

and coefficient of determination (R^2)

FIGURE NO.6. -- RELATIONSHIP OF COEFFICIENT OF CORRELATION (R) OF ZINC (dependent variable) WITH OTHER METALS (independent variables) -- cumulative



ZINC
Summary Table of cumulative values

	R	R^2
Lead	.49	24%
Silver	.63	39%
Uranium	.67	44%
Gold	.69	48%
Antimony	.70	49%
Manganese	.70	49%
Cobalt	.72	52%
Barium	.72	52%
Copper	.73	53%
Arsenic	.73	53%
Mercury	.73	53%
Molybdenum	.73	53%
Cadmium	.73	53%
Nickel	.73	53%
Cobalt/ Nickel ratio	.73	54%

CONCLUSIONS

The reconnaissance geochemical stream sediment survey of the subject area has outlined sample sites where anomalous metal contents were found (Map No. 3). Such anomalous values may be related to mineral deposits and deserve careful scrutiny. Field examination of the areas, which may include geologic mapping, alteration mapping of rock outcrops and detailed geochemical sampling, are some of the steps required to further define targets that may justify serious exploration efforts. Map No. 4 outlines areas which are considered to be the better areas for further scrutiny for precious and base metal mineralizations.

BLM manual defines mineral areas into 3 categories, namely, Undiscovered Resource Area, Identified Subeconomic Resource Area, and Identified Economic Reserve Area (Manual 1605 .42A6). Undiscovered Resource Area is defined by the BLM manual as:

Unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geologic knowledge and theory. Two subtypes may be considered, as described below.

(1) Hypothetical Resources--undiscovered materials that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals sufficient quantity and quality will permit their reclassification as a Reserve or Identified Subeconomic Resource.

(2) Speculative Resources--undiscovered materials that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in as yet unknown types of deposits that remain to be identified. Exploration that confirms their existence and reveals sufficient quantity and quality will permit their reclassification as Reserves or Identified Subeconomic Resources.

According to the above classification, the central portion of the study area, as outlined in Map No. 5, fits the classification of the Speculative Resource category of the Undiscovered Resource Area.

Map No.4 -- Outline of drainage areas with anomalously high gold, zinc and barium contents.

Gold

Zinc

Barium

Sample sites

SCALE

KILOMETRES 0 1 2 3 4 5 6 7 8 9 10

MILES 0 1 2 3 4 5

FEET 5000 0 5000 10000 15000 20000 25000

NATIONAL GEODETIC VERTICAL DATUM OF 1929

ELEVATIONS SHOWN IN METRES

TRIANGULATION STATION ELEVATIONS SHOWN IN FEET

GEOCHEMICAL STREAM SEDIMENT SURVEY OF HAWKS MOUNTAIN AND LONE MOUNTAIN AREAS HARNEY COUNTY, OREGON

Durga Rimal
Dennis Simontacchi
George Brown

Bureau of Land Management, Oregon
October, 1980

OREGON

Location

T 39 S

T 40 S

T 41 S

R 29 E

R 30 E

R 31 E

HARNEY CO

HUMBOLDT CO

MAP NO. 5 -- MINERAL AREA CLASSIFICATION,

ACCORDING TO THE BLM PLANNING SYSTEM

Undiscovered (mineral) Resource Area, Speculative Resource subtype for precious and base metals.

• Sample sites

SCALE

KILOMETRES

MILES

FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

ELEVATIONS SHOWN IN METRES

TRIANGULATION STATION ELEVATIONS SHOWN IN FEET

GEOCHEMICAL STREAM SEDIMENT SURVEY OF HAWKS MOUNTAIN AND LONE MOUNTAIN AREAS HARNEY COUNTY, OREGON

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OREGON

Location

Printed 1976

REFERENCES CITED

1. BLM Manual 1605: Unit Resource Analysis, Release 1-1965 dated 4/17/75.

2. Cathrall, J. B. and others, 1978, Mineral resources of the Charles Sheldon Wilderness Study Area, Humboldt and Washoe Counties, Nevada and Lake and Harney Counties, Oregon. U. S. Geological Survey Open-File Report 78-1002, P. 145.

3. Fenneman, N. M., 1931, Physiography of Western United States, McGraw Hill Book Inc., P. 326.

4. Lawrence, R. D., 1976, Strike-slip faulting terminates The Basin and Range province in Oregon: Geol. Soc. America Bull. 87, 1976, p. 846-850.

5. Mason, Brain, 1958, Principles of Geochemistry: New York, John Wiley and Sons, Inc., P. 310.

6. McLucas, G., 1980, Petrology of current Mount St. Helen's tephra, Washington Newsletter V. 8, No. 3, p. 7-13, Washington Dept. of Natural Resources.

7. Rankama, K. and Sahama, T. G., 1950, Geochemistry: University of Chicago Press, P. 912.

8. Shulters, M. V. and Clifton, D. G., 1980. Mount St. Helens ash fall in the Bull Run watershed, Oregon, March - April 1980: U. S. Geol. Survey Open-File Report 80-740, P. 9.

9. Taylor, S. R., 1964, The abundance of chemical elements in the continental crust - a new table: Geochim. et Cosmochim. Acta, V. 28, p. 1273-1285.

10. Walker, G. W., and Repenning, C. A., 1965, Reconnaissance geologic map of the Adel quadrangle, Lake, Harney, and Malheur Counties, Oregon: U. S. Geological Survey Misc. Geol. Investigations Map I-446.

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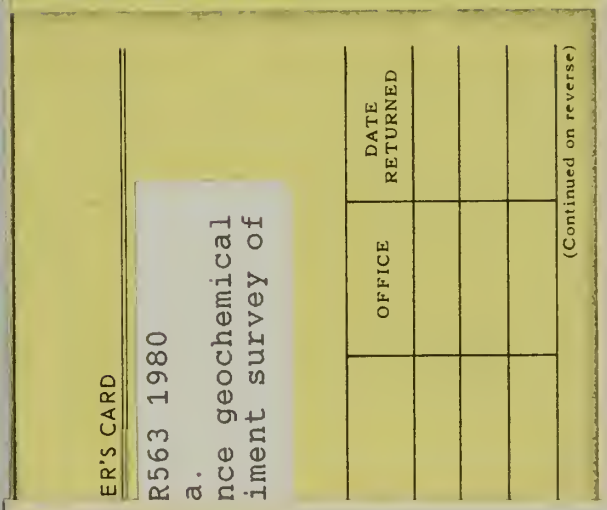

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